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VISUAL EVOKED RESPONSE (VER) DETECTION OF LOSS OF PERIPHERAL VISION

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FOR THE COMMANDER

JAMES W. BRINKLEY, SES
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13. ABSTRACT *(Maximum 200 words)*
A novel concept of objectively determining when a centrifuge subject and subsequently, a pilot, loses peripheral vision due to the physiological effects of sustained acceleration was attempted. The approach was to modulate lights in the peripheral vision of the subject as the subject stared at a centrally fixed indicator. It was demonstrated by using a special, lock-in amplifier, that a reliable visual evoked response (VER) could be elicited in the peripheral vision of a seated subject at 1 G. The next step, determining if the technique worked on subjects under sustained acceleration was never accomplished. Reliable, non-invasive means of monitoring centrifuge subjects came available during the later stages of this research which overcame the need to demonstrate this technique on the centrifuge.

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(U) Electroencephalograms, (U) EEG, (U) Peripheral Light Loss, (U) Acceleration tolerance, (U) Visual Evoked Response

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Objective: The objective of this research was to assess the feasibility of using visually induced steady state electro-encephalograms (EEG) to estimate acceleration induced peripheral light loss (PLL), rather than relying on subjects' subjective determinations of PLL. The goal was to use this technique as an objective measure of PLL during acceleration tolerance experiments.

Approach: Experiments were conducted in a normal 1-G environment to determine the optimal conditions (i.e., the precise form of the stimulus and the analysis technique) for obtaining the strongest EEG response to both foveal and peripherally localized stimuli. The visual evoked response (VER) was evaluated for both foveal and peripheral stimuli. A semi-circular light bar was constructed (Figure 1) and data were collected on both foveal and peripheral stimulation (lights A, B, C, D in Figure 1). A special amplifier was designed and developed which allowed a narrow band of EEG frequencies to be processed.

Results: Both on-axis and off-axis VERs were observed and recorded at 1 G. Only two subjects were evaluated for VERs stimulated by peripheral lights (Figure 1). The technique was never tested on the centrifuge. VER analysis took at least 3 seconds to complete which made the technique unacceptable for early detection of PLL during centrifuge experimentation.

Discussion: Although the technique of developing a VER by using lights modulated in the periphery of the test subject was demonstrated on at least two subjects, this technique was never evaluated on the centrifuge. Other objective means for monitoring the physiological status of the centrifuge subject became available, such as the ultrasonic flow transducer for temporal artery blood flow. In addition, researchers at USAFSAM, Brooks AFB, TX, completely instrumented subjects for recording EEG during a G-LOC study and found that the frequency of the brain waves shifts from high (alpha) to low (delta) when the centrifuge subject loses consciousness. The technique described here could potentially eliminate the subjectivity involved in estimating the sudden loss of peripheral vision (tunnel vision), but problems with detection and quick analysis of the VER preclude its use at this time. Other reliable non-invasive physiological monitoring techniques such as the transcranial Doppler device, pulse oximetry, and temporal artery flow velocity have been found to be acceptable techniques by centrifuge/acceleration researchers.

Conclusion: The concept of stimulating a visual evoked response by lights in one's periphery was novel in that it represented a potential objective means of determining when a human was losing peripheral vision as a result of the physiological effects of sustained acceleration. It was assumed that if one lost peripheral vision into a cone of 60 degrees, for example, that the VER from lights modulated outside the cone, say at 70 degrees, could no longer be evoked. The peripheral vision-evoked technique was not tested on the centrifuge because other non-

invasive physiological monitoring devices became available that eliminated the time delay problem.

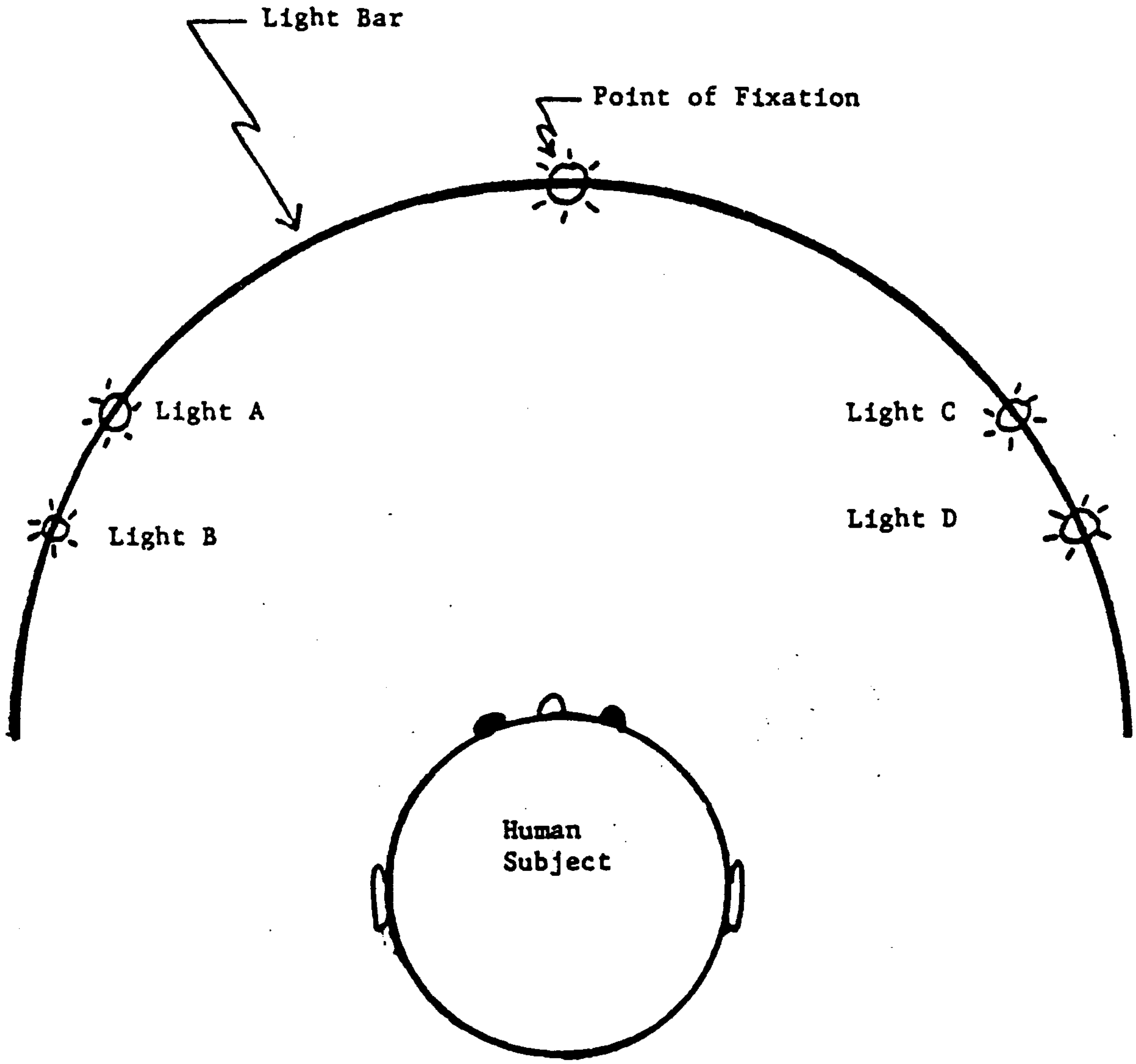

Figure 1: Top View of Conceptual Design For Using EEG Analysis To Determine Human Field-of-View